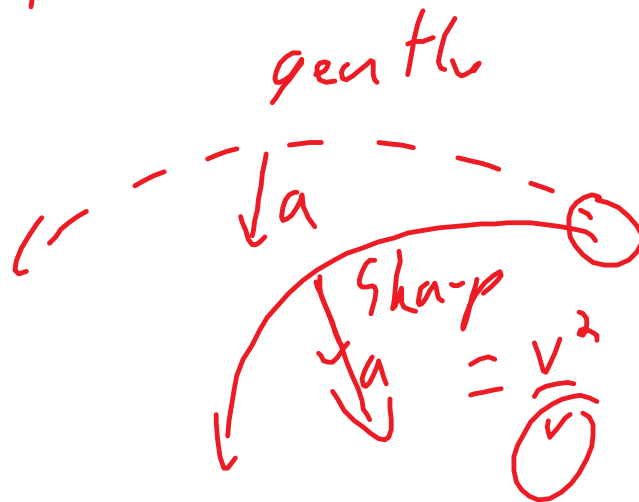
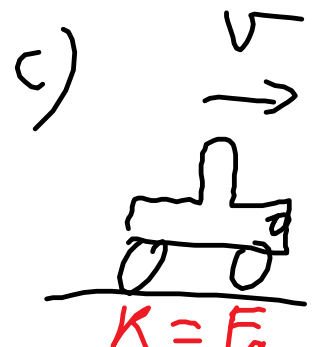
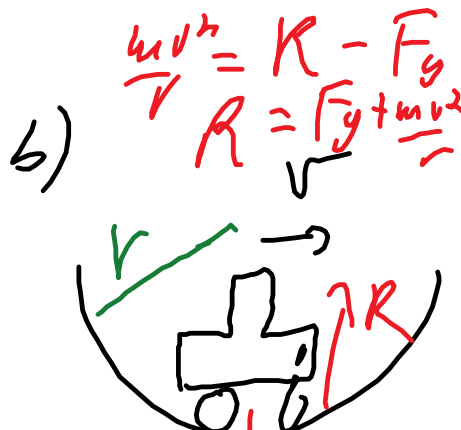
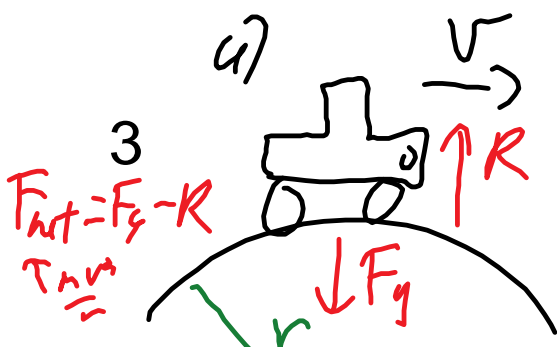
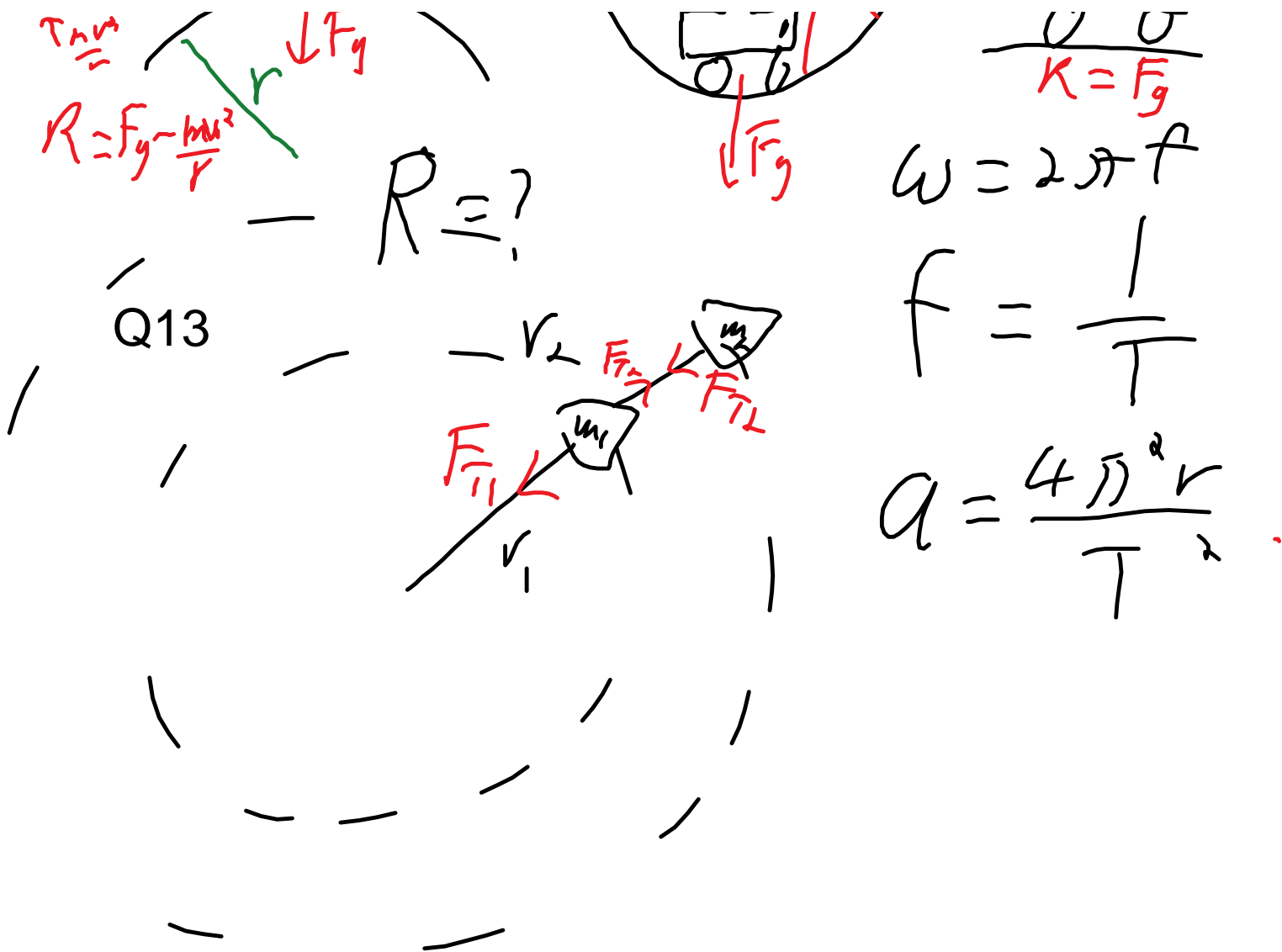


$p \parallel q$
 $a \perp v$



for a sharp turn, the change in direction of the velocity is greater, so a is greater
 $a = \text{change in } v$





Universal Gravitation and Orbits

What is gravity?

it goes down (Cindy)

Amy - 9.81 m/s^2

Alvina - attract to centre of Earth

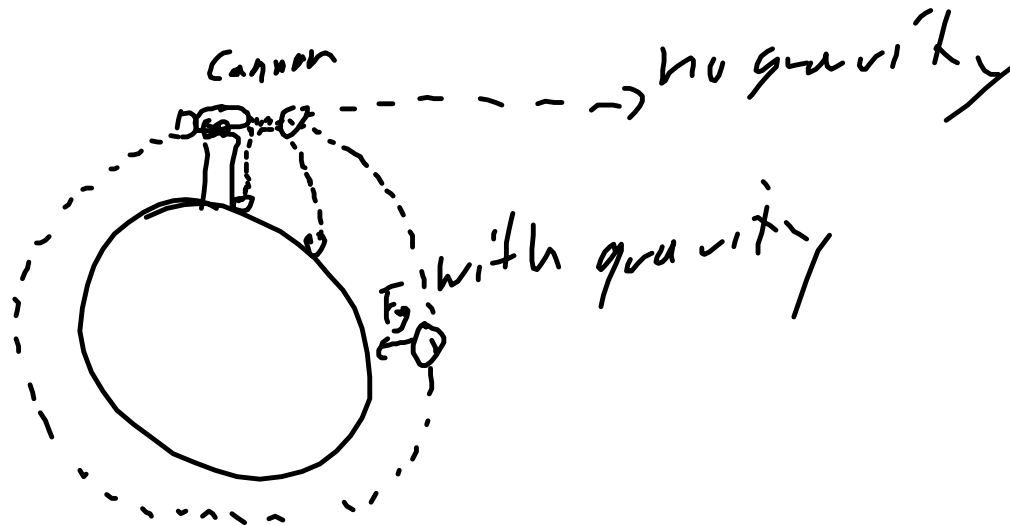
Newton - attraction

Story: The apple fell and he thought, "why doesn't the moon fall on my head like the apple?"

answer: The moon is falling but its inertia

carries it sideways so it misses - falls in circular orbit.

Think of a cannon on a tower:

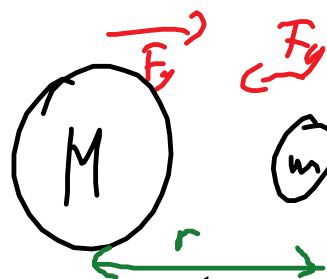


gravity pulls the ball in circular motion. If there was no gravity, it would move tangentially. What holds the ball or the moon up? Nothing, it falls in circular motion. F_g is the only force.

What velocity is required for the cannon ball, assuming the radius of the Earth is $6.38 \times 10^6 \text{ m}$ and the mass of the Earth is $5.98 \times 10^{24} \text{ kg}$ and

$$F_g = GMm/r^2$$

where



F_g is the force on each mass, towards each other. (equal and opposite)

M and m any two masses, in kg.

r is the distance between the two mass (if they are uniform spheres, treat the masses as being


points at the centre), in metres, m. (NOT KM)

G is the universal gravitational constant

$6.67 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$ (must be kg and m)

determine cannon speed (ignore air resistance)

p122 Q21-33 odds


$$F_{T_2} = m_2 a \quad f = \frac{1}{T}$$
$$F_{T_2} = m_2 \frac{4\pi^2 r_2}{T^2}$$

$$F_{T_2} = m_2 4\pi^2 r_2 f^2$$

$$F_{\text{net}} = F_c = F_{T_1} - F_{T_2}$$
$$\rightarrow F_{T_1} = F_c + F_{T_2}$$
$$F_{T_1} = m_1 4\pi^2 r_1 f^2 + m_2 4\pi^2 r_2 f^2$$
$$F_T = 4\pi^2 f^2 (m_1 r_1 + m_2 r_2)$$

'1
Cannon

* orbits *

$$F_{\text{net}} = \boxed{F_g = F_c}$$

$$\frac{GMm}{r^2} = \frac{mv^2}{r} = mg$$

\uparrow here Earth \uparrow here Earth

$$\frac{v^2}{r} = g \quad v = \sqrt{r \cdot g}$$

$$v = \sqrt{6.38 \times 10^6 \text{ m} \cdot 9.8}$$

$$v = \sqrt{6380000 \times 9.81} = 7911.24516116142$$

7.9x10³ m/s wow, fast